Current work and experience

- Lifetime measurement using new MC free method
- Wire-bond failure of CDF silicon module
- Other experience
    - L1 trigger rate study
    - Offline silicon monitoring

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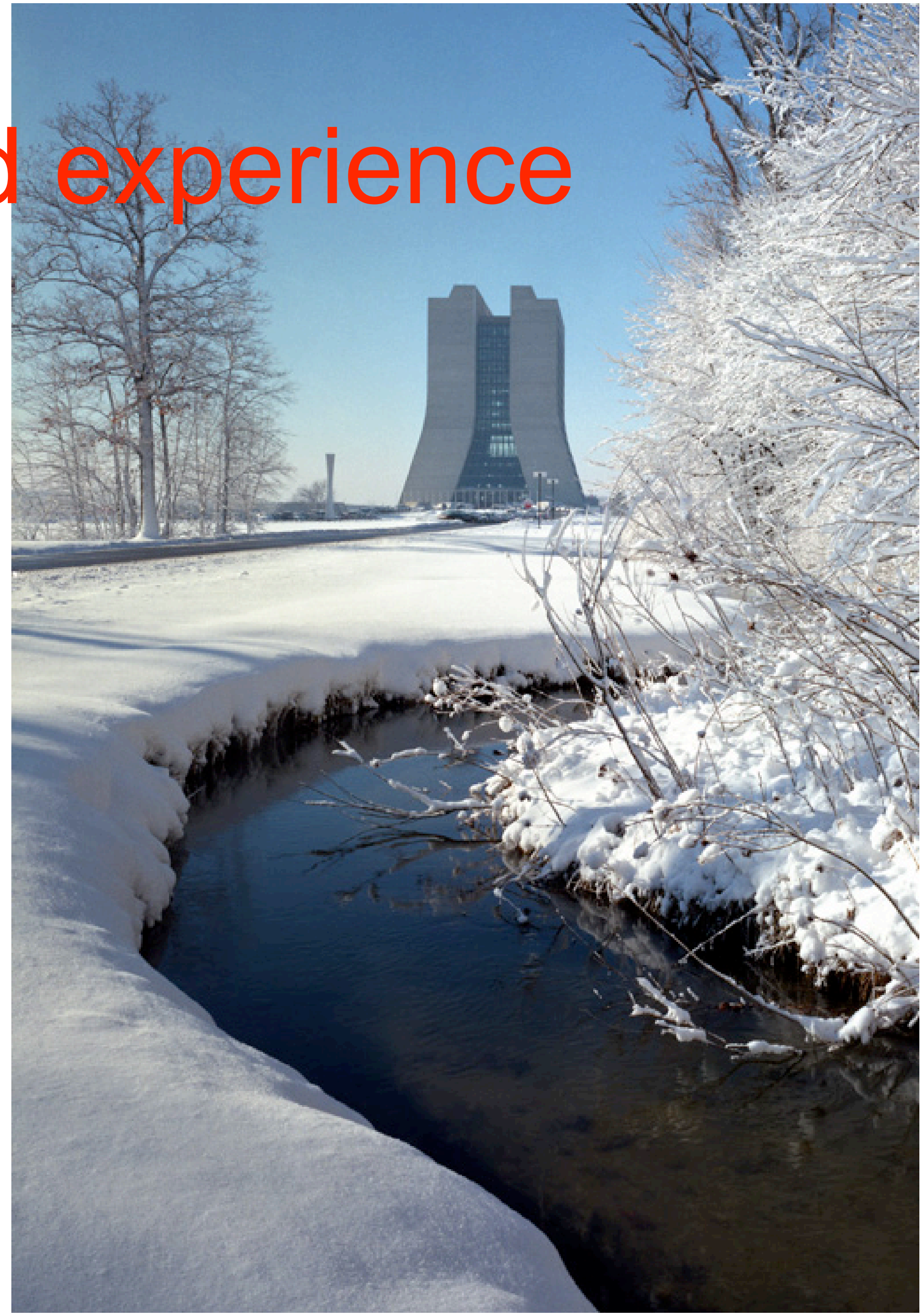


Why measure lifetime ?

- HQE (Heavy Quark Expansion) is used to predict the lifetimes hierarchy and ratios:

$$\tau(B^+) > \tau(B^0) \sim \tau(B_s^0) > \tau(\Lambda_b^0)$$

$$\boxed{\begin{aligned} \tau(B^+)/\tau(B^0) &= 1.06 \pm 0.02 \\ \tau(B_s^0)/\tau(B^0) &= 1.00 \pm 0.01 \\ \tau(\Lambda_b^0)/\tau(B^0) &= 0.88 \pm 0.05 \end{aligned}}$$

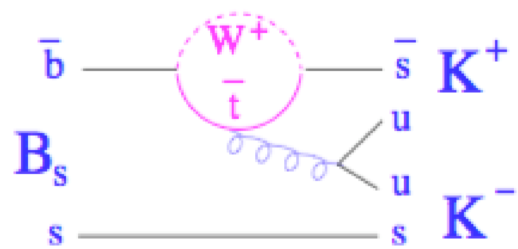
hep-ph/0310241

Measurement of lifetimes is good testing tool

- Decay width (Γ) is inversely proportional to lifetime (τ)

$$\Delta\Gamma_s/\Gamma_s = (10 \pm 5)\%$$

hep-ph/04122007



Sensitive to NP

- Trigger is crucial in collecting this data BUT biases lifetime distribution from being exponential

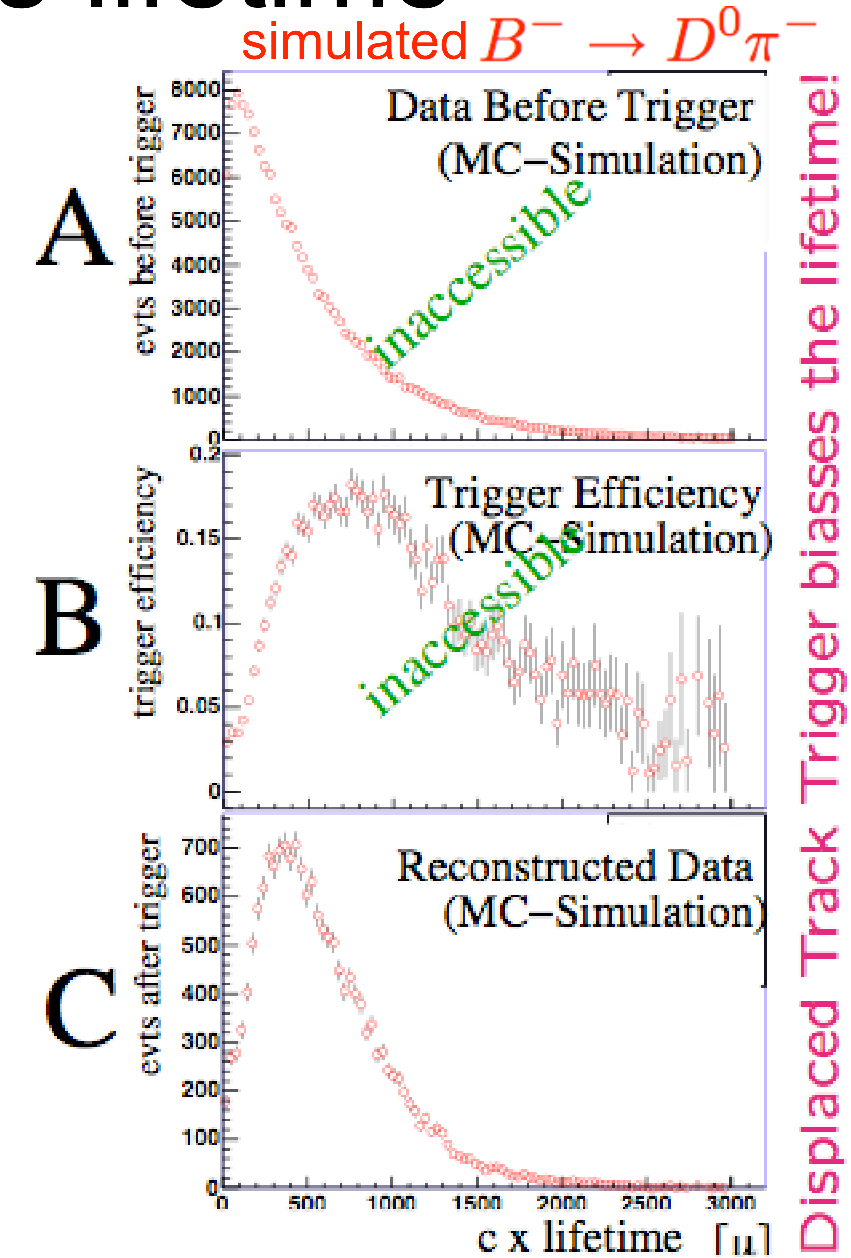
Efficiency vs lifetime

How to get from biased data C to the exponential decay time distribution A?

- Need a precise description of trigger efficiency (B)

- Traditional method: Use simulation to get trigger efficiency (B). But can we trust simulation?

- New method: Use data to correct for this bias on an event-by-event basis using event kinematics



MC free method

Probability to find an event with decay time t

$$
\begin{aligned}
P(t) &= P(t|t\epsilon[t_{min}, t_{max}]).P(t_{min}, t_{max}) \\
&= \frac{\frac{1}{\tau}e^{\frac{-t}{\tau}}}{\int_{t_{min}}^{t_{max}} \frac{1}{\tau}e^{\frac{-t'}{\tau}}dt'}.P(t_{min}, t_{max}) \\
&= \frac{\frac{1}{\tau}e^{\frac{-t}{\tau}}}{e^{-\frac{t_{min}}{\tau}} - e^{-\frac{t_{max}}{\tau}}}.P(t_{min}, t_{max})
\end{aligned}
$$

Independent of t

First term: Probability to find t given t must be between [t_{min}, t_{max}]

2nd term: Probability that t constrained to lie within those limits

Note: only difference for lifetime cut is the term in the denominator

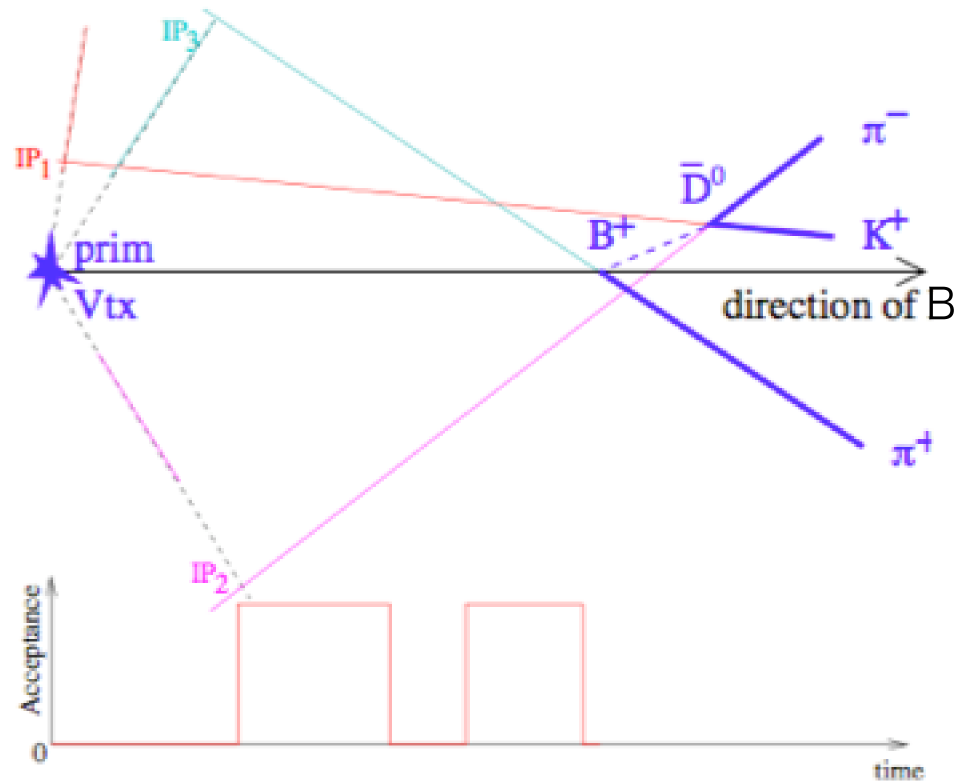
Task is to find these t_{min} and t_{max} on an event-by-event basis

Acceptance function

- Assume decay kinematics is independent of lifetime

- Slide the event in the direction of B and check if it would be accepted

- Note: unbiased event would be accepted at any lifetime



Acceptance function is a series of top hat function

Could be different for other topology

Signal only fit

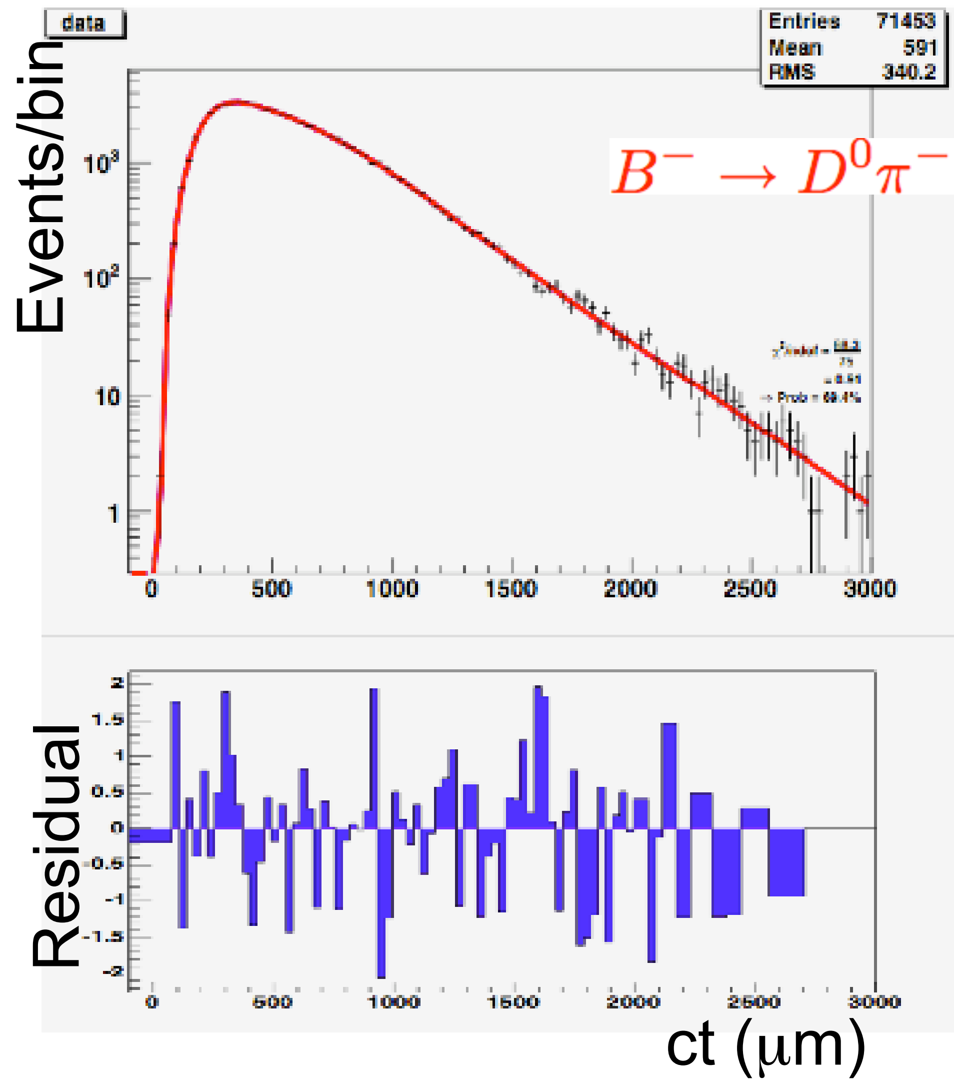
- Log likelihood fit to extract the best fitted lifetime

$$P(ct) = P(ct|c\tau, \sigma_{ct}, A_{trig})$$

- Extract lifetimes from variety of modes with different topology

Mode	Truth	Fit
Bu→Dπ	496 μm	495 ± 5 μm
Bs→φφ	438 μm	443 ± 5 μm
$\Lambda_b \to \Lambda_c\ \pi$	323 μm	319 ± 6 μm
B0→Dπ	464 μm	468 ± 4 μm

This build-up confidence



Fit including background

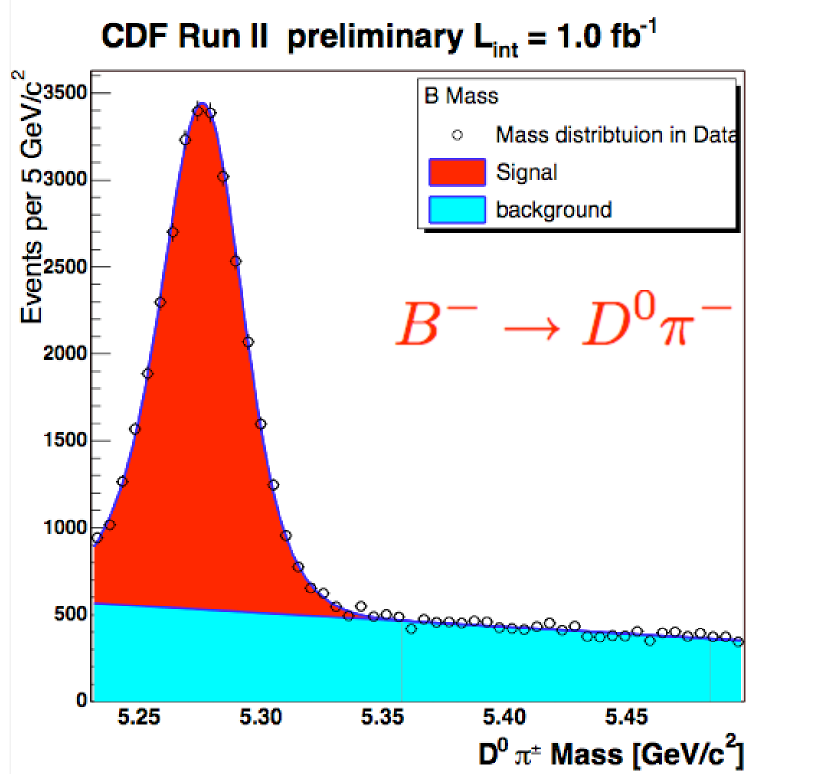
PDF with background:

$$P(ct) = P(ct|s) \times P(m_B|s) \times P(s|\sigma_{ct}, A_{trig})$$
$$+ P(ct|b) \times P(m_B|b) \times P(b|\sigma_{ct}, A_{trig})$$

- σ_{ct} and A_{trig} are different for signal and background
- This leads to "Punzi" effect

hep-ph/0401045

- Tricky signal probability as function of a function (acceptance function)



Lifetime results

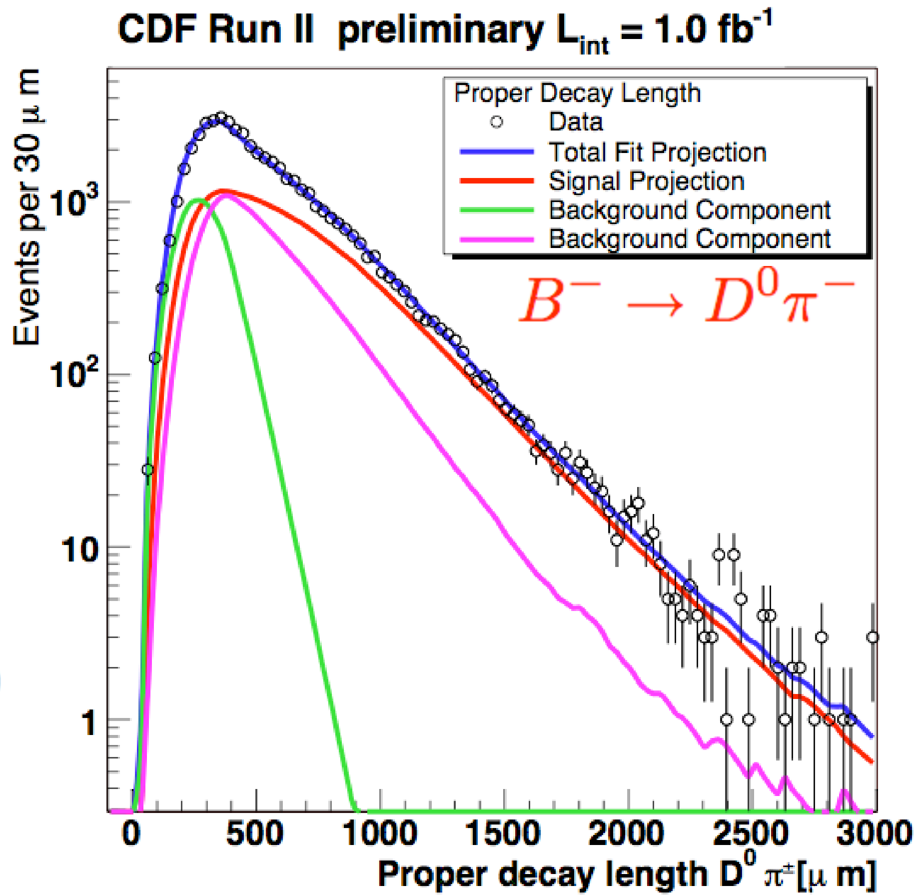
Lifetimes

$B_u^{\pm}: 488.5 \pm 6.2 \pm 4.4\ \mu m$

$B_d^0: 454.3 \pm 6.4 \pm 4.5\ \mu m$

Lifetime ratio:

$1.075 \pm 0.020 \pm 0.008$

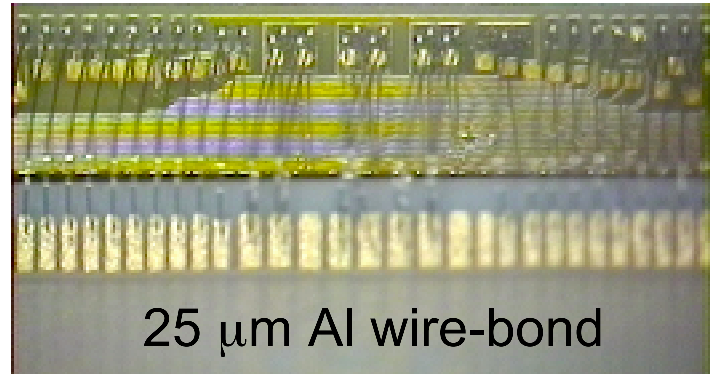


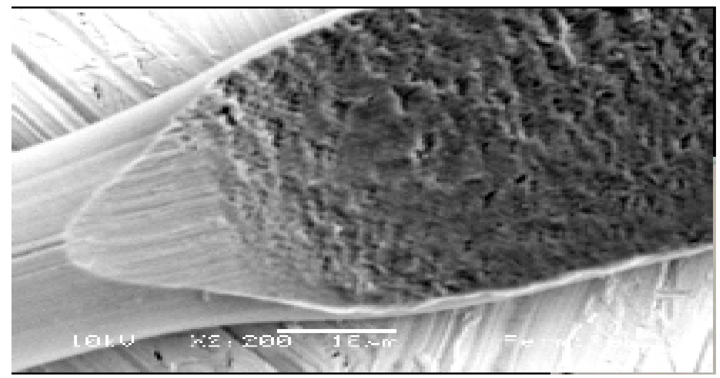
Wire-bond failure

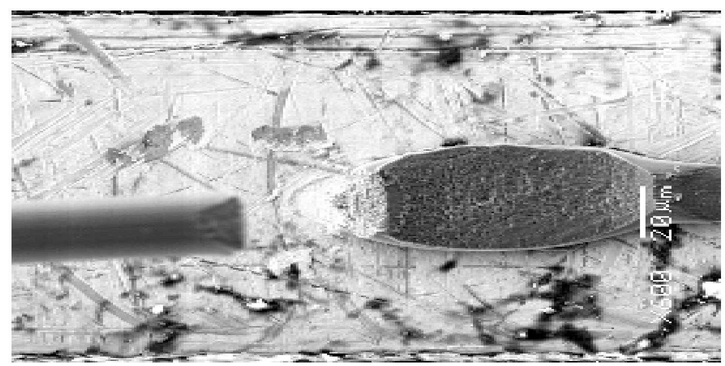
Investigate wire-bond failure of CDF silicon module:

- Wire-bond is widely used to send signal, commands and power connection
- Wire-bonds are perpendicular to magnetic field
- Synchronous readout can excite resonant vibration due to Lorentz force
- No failure reported since measures were taken

NIM A518 (2004)





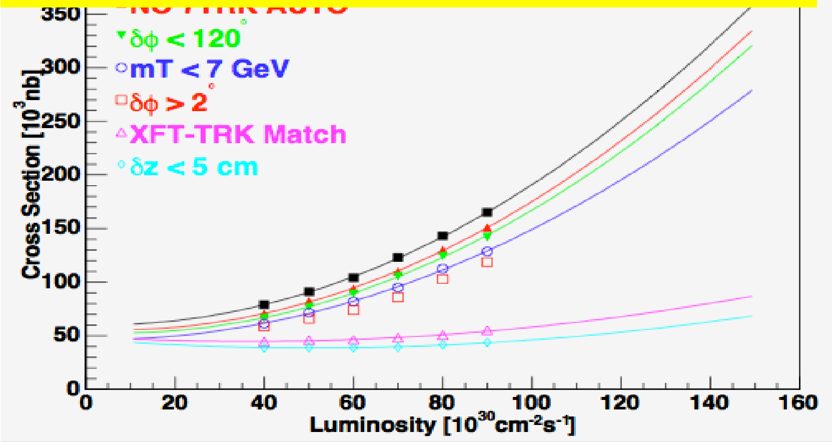


Other experience

Investigate L1 trigger rate:

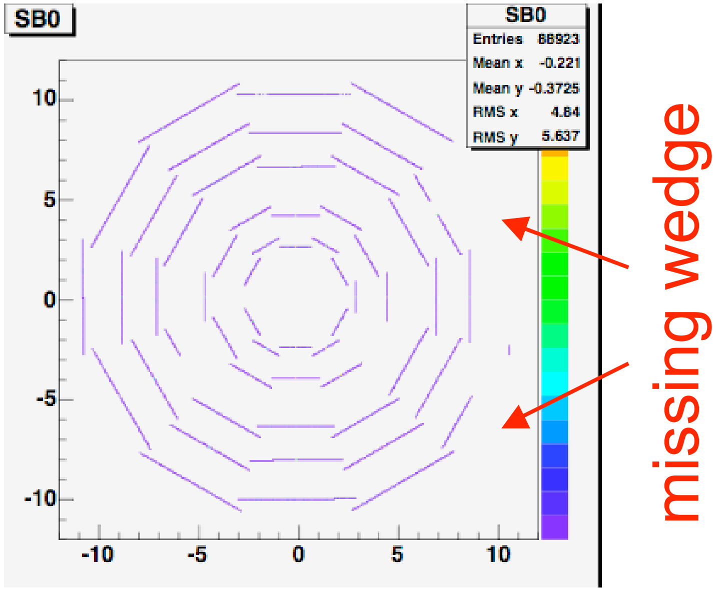
- L1 cross section grows with luminosity
- Identify cuts that reduce trigger rate with minimal physics data loss

Azizur Rahaman and Rolf Oldeman



Offline silicon monitoring tool:

- Make plots and post to the web to monitor the performance of silicon detector
- Run automatically by cron job:
  Using: C++, ROOT, shell scripting, perl, html



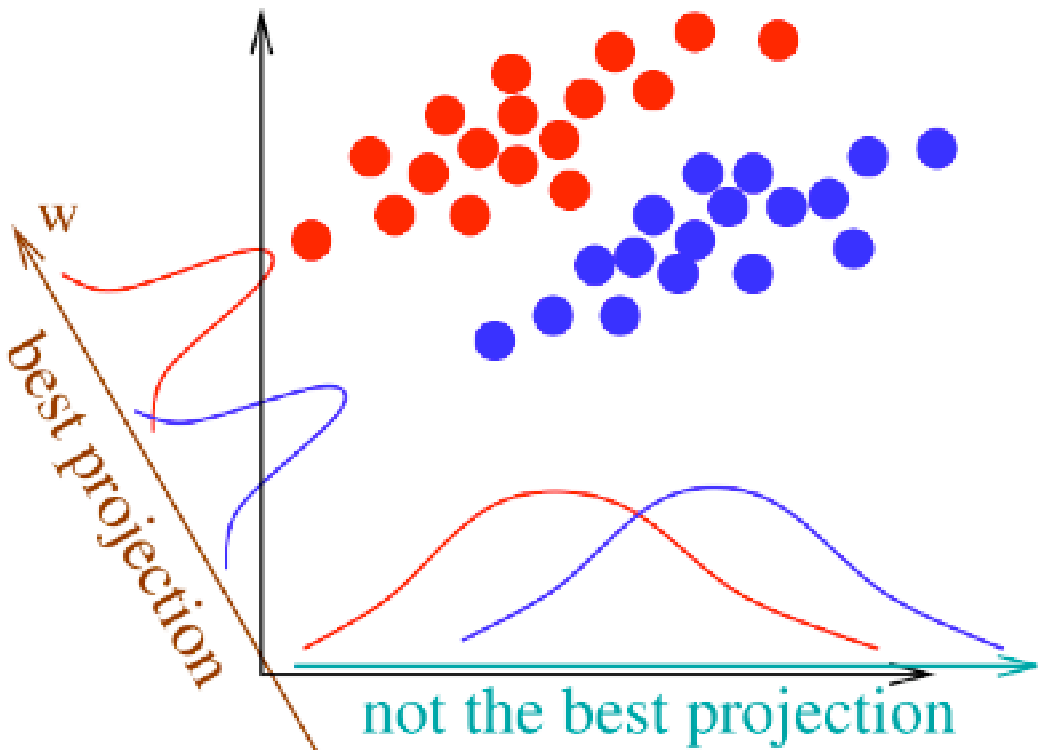
hit position in xy-plane

BACK-UP

Fisher Discriminant

Fisher Analysis: Fisher discriminant finds the direction (w) by

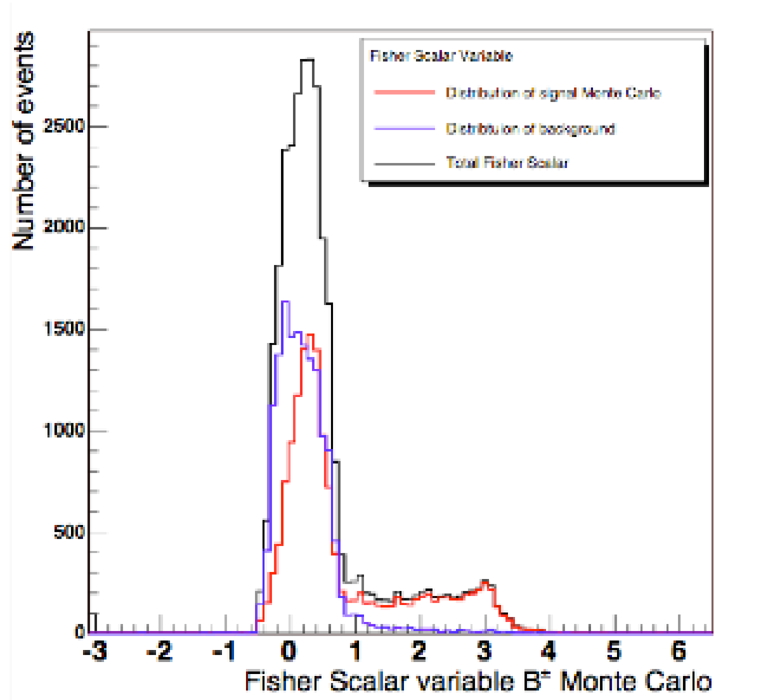
- maximize the separation of the projected means
- minimize the the spread of each class at the same time



- Slice the acceptance function in ct bin
- Height of Acc in each bin plus error on ct represent variables of vector v
- Fisher scalar (w.v) is the discriminating variable

Signal probability

- Divide signal by the total
- Get signal probability as a function of fisher scalar



- Fit this with Lagrange Interpolating Polynomial to get event by event information